Example 12: A 12 000 kg spaceship is 7.2×10^8 m from the center of a planet that has a mass of 5.1×10^{25} kg. As it "falls" back to the planet's surface, the spaceship gains 9.0×10^{11} J of kinetic energy. What is the radius of this planet?

$\Delta E_K = 9.0 \times 10^{11}$ J.

→ using conservation of energy:

before → $E_T = E_{P(old)}$

after → $E_T = E_{P(new)} + \Delta E_K$

before: $E_T = E_{P(old)} = -\dfrac{6.67 \times 10^{-11}(5.1 \times 10^{25})(12\,000)}{7.2 \times 10^8}$

$= -5.67 \times 10^{10}$ J.

after: $-5.67 \times 10^{10} = E_{P(new)} + 9 \times 10^{11}$

$E_{P(new)} = -9.567 \times 10^{11}$ J

$-9.567 \times 10^{11} = -\dfrac{6.67 \times 10^{-11}(5.1 \times 10^{25})(12000)}{r}$

$\boxed{r = 4.3 \times 10^7 \text{ m}}$